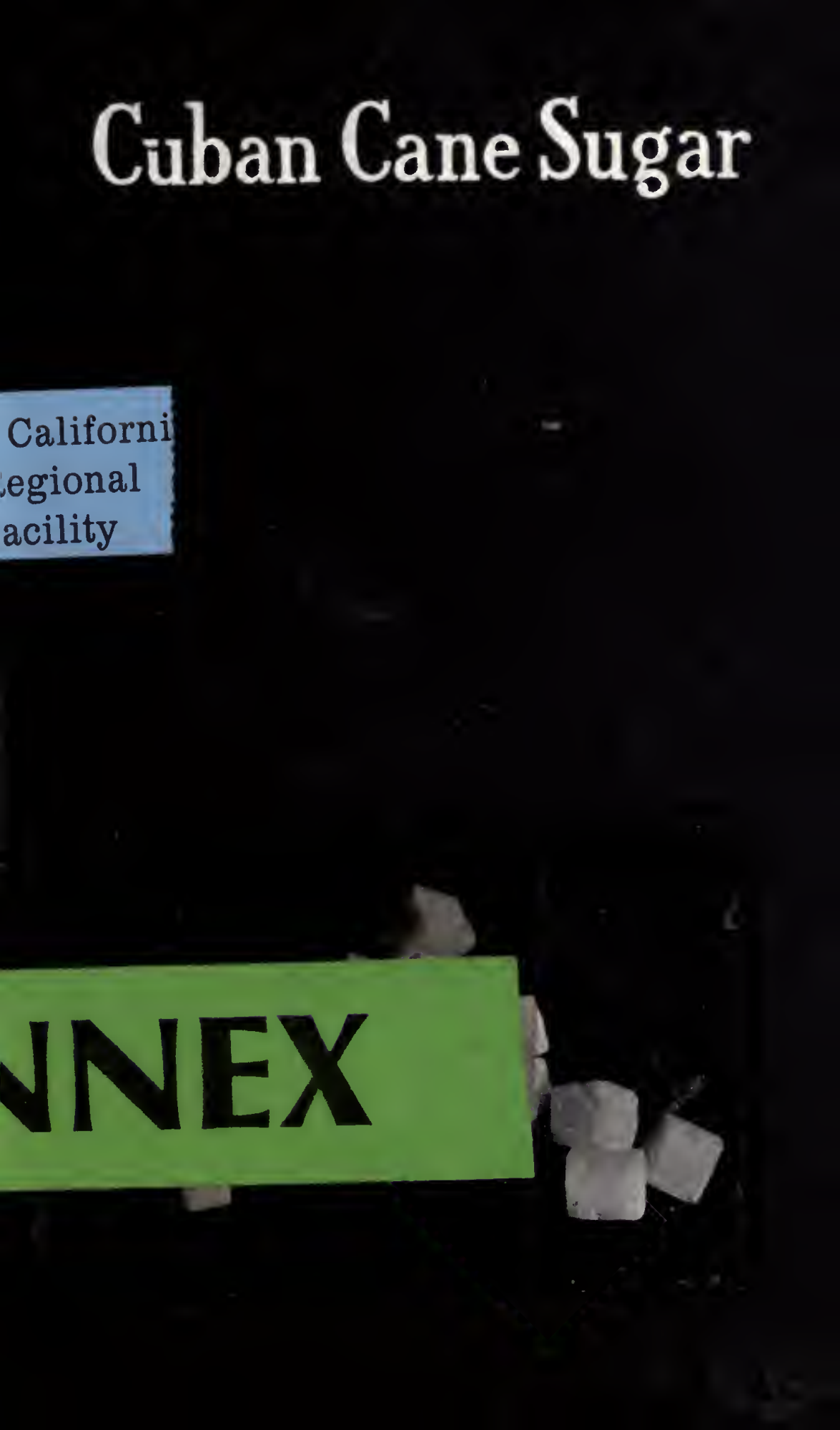
Cuban Cane Sugar



Cuban Cane Sugar

CANE CRUSHING IN CUBA

Cuban Cane Sugar

—a sketch of the industry, from soil to sack, together with a survey of the circumstances which combine to make Cuba the Sugar Bowl of the World

By
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ILLUSTRATED BY
SIX PHOTOGRAPHS

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A MODEL
CANE SUGAR
PLANTATION
IN CUBA

I. Our Sweet Tooth Growing Sweeter—And Why

OUR grandfathers, in the early '50s, got along well enough with a family sugar consumption of two pounds a week.

Our fathers' families in the '80s ate about five pounds a week.

Twenty years later, in 1900, we were eating more than six pounds a week.

Today every American family consumes between eight and nine pounds of sugar from Saturday till Saturday.

Not the sugar in fruits, or the sugars which we digest from the potatoes or beans we eat, or other natural sugars and sweets, but of commercial, store-bought, refined sugar we eat more than eight pounds.

Eight pounds, plus, of sugar a

week to the family—421 pounds a year—some of us eat less, and some of us eat more. The figures represent our actual national average.

In two short generations we have developed a national sweet tooth which calls for more than four times the sugar it formerly got.

Why?

* * * *

If we look for a moment at the sugar consumption of some of our less fortunate neighbors we may be able to see the reason, and to read the curious relation which seems to exist between sugar and prosperity.

While we are eating more than eight pounds of sugar a week, for example, the average Serbian family of five (in normal times) consumes but a bare fifteen ounces; and in Bulgaria, Roumania, and Italy, the family consumption amounts only to about a pound per week.

Our Sweet Tooth

The world over, we will find—with exceptions, here and there, to prove the rule—that the poorer a people the less sugar it eats, while the more spending money it has the more it uses—though, as we shall see later, sugar is one of the cheapest of foods.

The use of sugar might well depend upon many other things than prosperity. It might well depend upon the propinquity of a people to the sugar market (and consequently price); upon the character of other foods consumed—for obviously those whose principal diet is figs require but little store-bought sugar; upon the quantities of beer or other sugar-producing drinks a people uses; or even, on national tradition. But, it is interesting to note, from a table such as follows, how closely sugar and spending-money seem to go hand in hand:

	Per Capita Circulation of Money	Per Capita Annual Sugar Consumption
United States (1914)	$35.18	84.29 lbs.
Germany (1913)	19.29	45.13
Austria (1913)	12.08	29.17
Italy (1913)	8.82	11.68
Serbia (1913)	6.84	10.03

England, with a per capita circulation of money less than five-sevenths of our own, has an apparent statistical consumption of 93.37 pounds of sugar per capita as against our 84.29. These figures for consumption include, however, the sugar used in the manufacture of jams, marmalades and other preserves, much of which products are exported. If the amount of sugar so used and sent out of the country in manufactured form were deducted, and if our own consumption of England's manufactured sweets added to our quota, it would, no doubt, appear that England's per capita consumption was not so high as our own.

Our Sweet Tooth

France, with a per capita money circulation larger than ours, consumes less sugar—but the high cost of sugar in France, and the cheapness of wine, may in a measure account for this.

Australia, with $47.18 of money per capita as against our $35.18, might reasonably be expected to consume more sugar—and she does —100 pounds per capita per annum as against our 84.29.

The comparison is not only true as between nations. It is true as between sections of the same nation, as could easily be shown; and it is true as between different periods of a nation's prosperity.

Taking our own case, the comparative figures read:

	Per Capita Circulation of Money	Per Capita Annual Sugar Consumption
1850	$19.41	39.46
1880	26.93	58.91
1914	35.18	84.29

Cuban Cane Sugar

It would seem, if prosperity sweetens our sweet tooth, that adversity should have the opposite effect. But such is not the case. It is as if, in times of adversity, we were saying to ourselves, "We cannot afford more sugar—but we cannot get along with less" and so, as always, in such circumstances, we limit our expenditures, but spend, really, a little more than we can afford.

The figures show this. The decade, for example, between 1890 and 1900 was a period of protracted and general financial depression in the United States. At the beginning of this decade the per capita sugar consumption was 60.7 pounds, while at the end of the decade the consumption was 61.8 pounds. In other words, instead of cutting our sugar down to a point where it had formerly been, we kept it at just about a constant level.

And during the following ten years—1900 and 1910—a period recognized as one of unprecedented, general prosperity, we abandoned restraint, and our sugar consumption jumped from 66.6 pounds to 81.6 pounds per capita per annum.

* * * *

It would be putting the cart before the horse, however, to say that we use more sugar because we are more prosperous.

The simple fact is that we have come more and more to realize that sugar is a good food; as our prosperity has increased we have been better able to buy the foods we wanted or needed; in times of adversity we have merely cut down on those foods which cost more and gave us less value.

Where formerly we were told that sugar exercised an injurious physical effect, we know now that it is pos-

sible for us to assimilate only so much as is good for us—no more; and that if we eat too much sugar, the pangs of indigestion warn us of our error before any harm can come—if we pay attention to the warning.

Where, formerly, we thought that sugar must be bad for us because we liked the taste of it, we now know that sugar is demanded for the balanced ration, that it has a heat and energy producing value as great as lean meat, and that the nitrogen retention of proteid food, such as meat, fish, eggs and milk, is increased 25% when consumed with sugar.

A tabulation of the principal items of diet may be of interest:

Available Energy When Consumed As Food	
Meat and Fish	87%
Eggs	89%
Fruits	90%
Cereals	91%
Dairy Products	93%
Vegetables	95%
Sugar	98%

Our Sweet Tooth

When we realize that sugar costs only in the neighborhood of five or six cents per pound and that the other items listed run upward in price as high as forty cents per pound, most of them ranging between twenty and thirty cents, it will be seen why economy impels us to eat as much sugar as we can in connection with the other foods necessary to make a perfectly balanced ration.

That sugar is no longer considered a luxury can be convincingly read, also, from the statistics of candy consumption.

Our national candy bill runs well in excess of $500,000,000 a year. It amounts to more in a single twelve-month than the entire recent Anglo-French loan. It represents a per capita expenditure of more than five dollars a year. For many years we have been not only unapproached

by any other country in the consumption of candy, but have consumed more than all other countries reporting candy manufacture.

New York City is our largest candy consuming centre—the largest consuming centre in the world—both as to total consumption and per capita consumption.

At first thought we might say that New York is a city of wealth and prosperity and that its enormous candy consumption represents the gratification of a desire for a luxury.

But New York's candy is not sold to New York's rich—it is sold to satisfy the hunger of New York's poor. Where New York consumes one pound of high priced candies it consumes at least ten pounds of the cheaper grades such as are sold on the push-carts of Delancey Street.

From this we can only judge that there must be an economic reason

why our poor are the great candy consumers; their standard of living is so low, and the food available to them so inferior, that they feel, constantly, a natural hunger which they are most easily able to satisfy through buying the cheaper and more tempting sweets.

From the figures, the story of sugar is plain:

As we learn more and more the value of sugar as a food we buy more and more as our pocket-books permit us. Then, in times of depression like those we have just gone through, we eat slightly more sugar than usual, unconsciously, perhaps, because we reduce our consumption of the higher priced, less nourishing food-stuffs.

And, finally, with meats and grains mounting higher and higher, while sugar, because of improvement in methods of production, has steadily

gone lower, we turn more and more toward the consumption of sweets.

* * * *

There is still another factor which may loom large, in the future, in influencing the consumption of sugar, and which cannot be overlooked in a general survey such as this.

This factor is the prohibition movement.

A large percentage of all intoxicating liquors are made from the syrup which comes as a by-product in the manufacture of sugar; and all intoxicating liquors, whiskies, brandies, wines, beers, and ales represent only a chemical re-arrangement of sugar.

When the drinker stops taking alcoholic beverages, or even cuts down on them, he must and does use more sugar in his tea or coffee and his general dietary.

Although prohibition has been

definitely and steadily growing for more than thirty years, the fact has not as yet been reflected in the statistics of liquor consumption; during the decade 1904–1914 the consumption of liquors of all kinds increased nearly forty per cent., while the population increased only slightly over twenty per cent.

Nevertheless, state-wide prohibition has already been enacted in eighteen of the forty-eight States while local option prevails in sixteen, with several states soon to vote on the question. Moreover, when the Hobson resolution, to submit to the States the prohibition amendment to the Constitution, was laid before the House, 197 members voted for it, 169 against it.

So we see that the prohibition wave is a thing of fact, not of fancy. Whether or not it will effectively stop the consumption of liquor, it

must, if only by reducing it, increase the consumption of sugar.

* * * *

We see, thus, that the advance of sugar goes hand in hand with the advance of intelligence and prosperity; that adversity only slightly checks the advance; that the high cost of living and the prohibition movement, both of which promise to be with us for many years to come, tend to increase consumption.

As a result of the operation of these factors, our national sweet tooth has been growing sweeter and sweeter—not only ours, but that of our neighbors.

And the sum of this increase in the use of sugar is indelibly written in the statistics of world sugar production, as follows:

In 1870 the total production of cane and beet sugar in the whole world was 2,750,000 tons.

In 1914 this total had risen to 18,773,486 tons—a jump, in a single generation, of more than 600 per cent.

As matters stand today we are digging out of the ground, the world over, only about one-third enough gold to pay our annual billion-and-a-quarter dollar raw sugar bill.

All of the petroleum produced in the world in a year equals hardly more than one-quarter the value of the year's raw sugar crop.

All of the ever increasing quantities of tobacco used amount in value to barely a third of what we pay for our raw sugar.

And coffee, too, growing apace with tobacco, would have to multiply its annual crop by more than four in order to be abreast of sugar, while rubber, with more than two million motor cars consuming it at an astounding rate, must be multi-

plied by almost six before it equals in value the crystals which our canes and beets are producing annually to satisfy our sweet tooth.

The world's sugar crop is bigger than her cotton crop—much bigger. It is exceeded, in fact, only by the grain crops and the production of live stock.

* * * *

If the demand for sugar increases during the next fifty years as it has during the past fifteen, we must increase our facilities for producing it to at least seven times their present capacity.

But if the demand should not increase at all, if sugar should come to a sudden standstill, the importance of this crop among the world's basic productions has, during the past hundred years, been established beyond question or doubt.

MODERN
SUGAR-MAKING
MACHINERY

II. Sugar Making—From the Soil to the Sack

Those of us who have known the boyhood joy of a maple sugar camp in full swing, may think that the granulated sugar of commerce is made by the same process—boiling, boiling, boiling, and draining.

It is not. It is not even made from molasses as our geographies used to state. The molasses is, in fact, a by-product of sugar manufacture—not, as many suppose, its starting point.

There is an important difference, in fact, between syrup and molasses. The former is the juice or sap of a sugar producing plant, boiled and clarified, and containing its entire original sugar content; the latter is the residue after the sugar crystals have been extracted from the syrup.

Cuban Cane Sugar

Before going into the details of the interesting process of sugar making itself, it may be said that all of our commercial sugar is cane sugar.

No matter whether it comes from the juice of the beet, or the sap of the bamboo or maple, or from cane itself, chemically and technically it is known as cane sugar.

* * * *

There are two classes of sugar in nature—which, avoiding long Latin names, may be called single sugars and double sugars. Cane sugar, milk sugar, malt sugar, are some of the double sugars. Grape sugar and fruit sugar are common single sugars.

If we take a double sugar and submit it either to heat, acid or ferment, we turn it into single or *invert* sugar.

The double sugars are of no use as food while they remain double—they cannot be assimilated in the

body for the formation of organic tissue or the production of heat and energy. Only the single sugars are available.

But, practically, this is of no consequence since the acidity of our digestive juices, the heat of our bodies and our digestive ferments combine to form ideal conditions for inversion, and accomplish this chemical change shortly after we have eaten the double sugar.

Cane sugar has two and one-half times the sweetening power of fruit sugar and more than two and one-half times the sweetening power of grape sugar—which is one of the reasons why all of our commercial sugar is cane sugar instead of the more easily assimilable single sugars.

* * * *

There are countless plants in nature which may be made to yield us cane sugar. All fruits contain two or

more sugars, of which cane sugar, fruit sugar and grape sugar, are the most important.

For centuries sugar has been manufactured from different species of palms by the natives of India. The bamboo is a sugar-producing plant which was utilized by the ancient peoples of Asia and is supposed to be the first plant from which sugar was extracted. Sugar is manufactured from raisins in practically all the countries of southern Europe and western Asia. Indian corn has been used experimentally in the manufacture of sugar, while Sorghum or Chinese cane, with a high sugar content, yields a large syrup crop, but for chemical and manufacturing reasons little or no actual sugar. The saps of many trees besides the maple contain sweets. Sugar and syrup have even been manufactured in the United States from water-

melons—an industry which was nipped in the bud by the introduction of refrigerator cars and cold storage, which made a wider and more profitable market for the melons themselves.

But for practical purposes the commercial sugar of the world can be considered as coming from the juice of the cane or the beet. The consumption of all other sugars amounts to but a small fraction of a per cent.

* * * *

Whether our sugar is to be produced from beets or cane, the first step is the production of the syrup—the separation of the sweet watery content of the plant from the pulp or woody portions.

In the case of cane, the operation is simplicity itself. All that is needed is crushing.

The pioneer methods of milling and crushing in the cane growing

countries of the world were crude almost beyond belief. The first crushers consisted of wooden rollers —two adze-hewn logs—usually vertical, operated by hand-power. Twenty-five per cent. of the total juice represented all that could be extracted by this means.

The first improvement—and this came not so many years ago—was the substitution of vertical cast-iron rollers, which, in construction and manipulation, differed little from the old wooden rollers, but added an extra fifteen per cent. to the total of the juice extraction. The next advance was marked by the introduction of steam-power, which permitted an increase in the size of rollers; and finally this improvement was followed by the introduction of horizontal instead of vertical rollers. These raised the efficiency of extraction to sixty-five per cent.

Steel rollers are now used almost exclusively in the larger mills and the number of rollers has increased from one pair to three and from three to nine. Many of the mills have shredders or corrugated crushers, through which the cane is passed before conveying to the smooth rollers. Cane prepared in this way yields from eighty to ninety per cent. of its total juice, while still higher percentages are secured by saturating the *bagasse*, as the crushed cane is called, with water and passing it through the mill several times.

The process, despite this lengthy description, is simplicity itself. All that is required is to extract the juice from the cane by crushing—and with the present advance of engineering and invention in this line, the day is in sight when practically all of the available juice can be separated and saved.

In the case of beet sugar, the process is more difficult and expensive. First the beets must be thoroughly washed to cleanse them of the quantities of field earth which adhere to them. In the early days of the beet sugar industry it was the custom after washing to pulp the beets and effect the extraction of the juice by pressing, much as cane is pressed. But this method is so wasteful and so inefficient, because of the structure of the beet, that it has been abandoned and a diffusion process substituted.

The first operation in the diffusion process is to slice the beets into the thinnest possible individual pieces. This is done by a machine which cuts the beets with a multitude of curved knife blades, revolving rapidly. When the beets are cut into thin, irregular slices on this machine, they are placed, in water, in the first

of a set of cylindrical vessels called a diffusion battery. These vessels communicate with each other by pipes so arranged that the juice issuing from the bottom of one diffuser flows into the top of the next. By this means the sugar content is dissolved and the sweet, viscous liquid or syrup which is the starting point of both beet and cane sugar is secured.

* * * *

This viscous liquid as it comes from the mill, whether from cane or from beets, is subject to almost immediate fermentation, since it forms an ideal culture for the propagation of germs. If allowed to stand, it will quickly sour and invert into single sugar.

It is a curious point about the sugars, well worth noting here, that in weak solutions they are easily fermented, while in concentrated

solutions they are able to preserve themselves from the attacking germs. The grape, for example, soon decays after it is taken from the vine. But if its sugar is concentrated, as in the raisin, it will keep indefinitely. The same is true of our other table fruits. Fresh fruits soon spoil; those which we protect by concentrating their sweets we call preserves, and these we can easily carry over one or more winters.

The susceptibility of freshly milled syrup to fermentation calls for immediate attention; if left a few hours it may sour. So the first operation is to boil it. At this stage it is a turbid, dark-colored liquid, full of woody and gummy constituents, wholly unfit to be worked up into sugar without clarification.

Protection against micro-organisms, as stated, is accomplished simply enough by boiling. The

boiling kills the germs which are present, the evaporation concentrates the sugar solution and prevents further invasion, and the heat coagulates the albuminous constituents of the syrup, forming a froth, which, when removed, has accomplished much in the process of clarification.

Besides heat, which coagulates the albumen, another agent which has been used for clarification from the earliest times is lime. This precipitates the gummy matters which form into a muddy sediment at the bottom and into a top layer of froth between which the bulk of the juice is clear and limpid.

Thus we see that the first step after the juice leaves the mill is to boil it and to add a measured quantity of milk of lime, or in plainer English, whitewash. This whitewash, much as we should dislike to

drink it, has no effect whatever on the sugar. It attacks only the impurities, both dissolved and suspended, but does not combine with or alter the sucrose itself.

When the syrup has been clarified by boiling and liming, it may be said to consist of two elements—sugar and molasses. The sugar is represented by that portion which can be crystallized out, the molasses being the residuum.

The sugar crystals are now separated from the molasses by whirling it rapidly in a machine called a centrifugal. This machine consists essentially of a perforated basket, revolving inside an iron casing. The basket is lined with finely perforated sheet bronze or with woven wire cloth and may measure from fourteen to twenty-four inches in depth and from thirty to forty inches in diameter. Revolving at a speed of

from 1,000 to 1,400 revolutions per minute, the molasses is forced out through the fine openings, caught in the iron casing and carried off in a conduit, while the sugar crystals themselves are retained in the basket. The basket is spun until the sugar is practically free of molasses; such sugar is then known as raw, or centrifugal, sugar. It is definitely crystalline in character, but still moist and lumpy. Its color, due to the impurities it still contains, varies from a light tan to a dark brown.

* * * *

The molasses which has been carried off in a conduit is now boiled again, replaced in the centrifugal for the extraction of still more crystals, which are kept separate and called "molasses sugar." When this process has been carried to its profitable limit, the final molasses is sold for

the manufacture of rum, whiskey, or other spirituous liquors, or for the manufacture of alcohol. There are many other markets for molasses, including the manufacture of stock foods, its use as a fertilizer, etc., but its conversion into alcohol and spirits represents its chief use.

* * * *

The raw sugar from the centrifugals is still unfit for use, and must now be refined; in refining, it is first dissolved in hot water, the liquor thus formed being filtered through cotton bags to remove all insoluble impurities. It is next run into iron cylinders packed with charred bones, bone charcoal having a peculiar affinity for the soluble impurities and leaving the sugar, after filtration, in a purified and decolored condition. This purified, colorless, liquid sugar is now boiled in vacuum pans, refilled as evapora-

tion sets in, until the crystals have begun to re-form, when the mass is again spun in centrifugals which separate the crystals from the liquor as before. These crystals, after drying in horizontal cylinders, are turned out as the granulated sugar of commerce.

If soft white sugar is desired, the process is stopped after passing through the centrifugals. The granulated grades are obtained by controlling the crystallization in a granulator and by sieve grading.

Loaf sugar is made by running the mass from the vacuum pans into molds, where it drains; and then placing the molds in ovens to be solidified. Pressed cubes are made from moistened granulated sugar.

The liquor taken from the centrifugal machines is reboiled and yields the soft or brown sugars, and the final residue is sold as molasses.

Cuban Cane Sugar

In technical and trade descriptions of sugars we often find the expression "96° centrifugal." The "centrifugal," we now understand, refers to the process by which the sugar was made—that is, as against boiling, evaporating and draining, as is done in the case of maple sugar and as was formerly the practice before the days of improved machinery in cane sugar.

The "96°" refers to the *quality* of the sugar and brings up the curious method in vogue for determining sugar quality.

Sugar is not, as might be supposed, tested by taste for its sweetness or by any of the chemical means which might be suggested, but is judged by the way in which it refracts light.

We know that when we poke a stick into a pond the part of the stick below water seems bent and fore-

shortened; and that when we pass light through glass at an angle its direction is changed.

Similarly, sugar in solution has the property of bending the rays of light which it refracts; different sugars have different refractive properties; and in actual practice sugar, instead of being tasted or analyzed, is examined by an instrument called the polariscope, designed to measure the character of this refraction.

Fruit sugar bends the ray of light to the left. Its technical name is *Levulose*, and is, in fact, called a left-hand sugar; cane sugar (*sucrose*), and grape sugar (*dextrose*), bend the ray of light to the right, and are known as right-hand sugars.

The polariscope readings of some different commercial sugars are: Black Strap 71°, Cuban Molasses Sugar 77°, Cuban 1st Sugar 96°, and Java White Sugar 99.6°.

We have before us, now, a general survey of the methods by which our sugar crop is commercialized. There are many by-processes not necessary to describe here—many ingenious short cuts—and many efficient means of utilizing the sugars in waste products of manufacture, but the process as a whole follows the lines described here.

Thus we see that the essentials of sugar making are:

1. A plant such as cane or the sugar beet, which yields sugar economically in crystallizable form.
2. A means for separating the juice from the woody and other constituents of the plant.
3. A means for clarifying, purifying, and making germ-proof this juice or syrup.
4. An apparatus for separating the molasses from the sugar

crystals — a centrifugal machine.

5. A means for washing and filtering the raw sugar thus produced and of reducing it to the clean, pure, white crystals of commerce.

In the manufacture of beet sugar, these operations are frequently carried on under one roof; the beet sugar factory may well be a complete institution, buying its beets from the neighboring farmers (often furnishing them the seed and supervising their crops), and turning out a complete commercial sugar.

This arrangement is possible, in the case of beet sugar, because sugar beets can be grown in climates and localities suitable for manufacturing.

In the case of cane sugar, however, the process is split in two. Cane is a product of the tropics and semi-tropics where sugar refining could be

carried on, for several reasons, to poor advantage. The cane planter, therefore, converts his crop of cane immediately into raw sugar on his own premises, or in the neighborhood, and this raw sugar is sent to refiners in the country of consumption, where the after-processes are carried out.

* * * *

The making of sugar, from the soil to the sack, is a simple process, and an interesting one; considering that it has only lately been rescued from the primitive, considering the advancements already wrought, and considering its ever increasing importance among the world's productions, one can but wonder what new efficiencies and what further economies inventive genius holds in store for it.

CENTRIFUGALS IN WHICH THE SUGAR CRYSTALS ARE SEPARATED FROM THE MOLASSES

III. Cane vs. Beet—The Struggle for Supremacy

We owe the discovery of cane sugar to the Bengalese in India; as long ago as the third or fourth century A. D., travelers from India brought back news of "Indian salt." From the fifth century, we can trace its spread into Arabia, Egypt, Spain, Portugal, the Canary Islands, Brazil, Cuba, and so on around the world.

But the making of sugar out of beets we owe distinctly to Napoleon Bonaparte. It is just 110 years since Napoleon gave the beet its impetus, and the circumstances were these:

In 1804–5 the business affairs of Europe were in much the same tangle as they are in the war times of today.

Napoleon was successful in bat-

tering down the continental frontiers and in increasing his possessions amazingly—but he met failure in his principal task—that of humiliating his chief enemy, Great Britain; and, in 1805, he was forced to give up his intention of attacking that country when Nelson destroyed the French fleet off Trafalgar, consequently preventing the landing of the French in England.

When, in the end, Great Britain established herself as mistress of the seas, and succeeded in opening trade relations with the continent, in spite of Napoleon's strenuous efforts to forbid them, the French Emperor devised what was known as the "Continental System" which dealt a disastrous blow to the cane sugar industry.

Seeing that the struggle was not to be brought to an end by fighting, Napoleon tried to isolate his enemy

by forbidding commercial communication between England and the entire continent of Europe.

When this decree was issued and all British and Colonial goods were confiscated, England sought reprisal by prohibiting ships of any nationality from approaching French harbors on the penalty of confiscation; whereupon Napoleon, in turn, decreed that any ship which had either submitted to English examination or had paid dues in English harbors be confiscated.

With both sides engineering bitter blockades, shipping came to a standstill and sugar prices on the continent went up, and up, and up to prohibitive figures.

Meanwhile, the lack of sugar became an important war-time problem which demanded immediate and vigorous action. Napoleon set about, at once, to find substitutes for cane

sugar which might be grown in France. In his search he learned that sugar could be produced from grapes and from beetroots, but he did not confine himself to these, experimenting meanwhile with apples, pears, plums, quinces, mulberries, chestnuts, figs, sorghum, field corn, and the saps of several trees.

Nearly sixty years previously, Marggraf, in Berlin, had shown that various kinds of beetroot contained sugar which could successfully be crystallized out. Forty years later Achard, a Frenchman, experimented with different varieties of beetroot; and, when his results became known, Frederick Wilhelm III, King of Prussia, started experimentation on a large scale and contributed toward the erection of several sugar factories, at the same time offering bounties to farmers who produced

more than twenty tons of beetroot a year.

After a number of costly experiments had been directed toward the production of grape sugar, with poor results, Napoleon, in 1811, ordered 32,000 hectares—about 75,000 acres—to be planted with beetroot—distributed over the several provinces—and established four schools in which sugar manufacture was to be taught. In the meantime, he stifled whatever little competition cane sugar might still be offering, by forbidding all further importation from the East and West Indies. In 1812 the number of sugar schools was increased and 100,000 hectares—247,100 acres—were planted and by that time 334 factories were in operation.

The news of the new sugar industry soon spread and Austria and Germany vied with France in their efforts to produce the crystals from

beets. In 1814 when Napoleon had to abdicate, his "Continental System" was abolished, and imported sugar was again admitted on the continent. This proved but a temporary set-back to the new industry, however, so rapid had been its rise and so great the enthusiasm which attended the discovery. By 1830 the beet sugar industry was in full swing once more.

* * * *

Cane, having always been considered the natural source from which to expect sugar, received little attention or promotion. While the best minds of Europe were studying the beet, improving the varieties, inventing new and more efficient means of extraction, and generally giving the subject serious consideration, cane sugar continued to be produced in the most primitive way.

It was not, in fact, until the early

'80s that the cane planter woke up from his long sleep.

The typical owner of a sugar plantation lived in tropical style, well up to his income and invested the least possible money in improvements. He was prone to spend all he made without thinking of creating a reserve fund, and consequently, when the beet—all things considered, a much inferior plant to the cane for the purpose—began, by sheer dint of scientific handling, to encroach upon the cane, he was absolutely unprepared for the struggle for existence which lay before him. This condition, however, did not continue long, and in the early '80s, capital, in moderate amounts, began to be available to sugar planters, and cane sugar manufacture began to shake off its primitive shackles.

In 1870 the production of cane sugar was almost double that of beet

sugar. By 1880 beet sugar had climbed up to a point of approximate equality, and then, as stated, the struggle began.

The story of the race is indelibly written in the figures of World's sugar production, (Mulhall and Willett & Gray), which are quoted here:

Years	Cane	Beet	Total
1870	1,850,000	900,000	2,750,000
1880	1,860,000	1,810,000	3,670,000
1890	2,580,000	2,780,000	5,360,000
1898	2,850,000	4,650,000	7,500,000
1900	3,056,294	5,590,992	8,647,286
1902	4,079,742	6,913,504	10,993,346
1903	4,163,941	5,756,720	9,920,661
1904	4,234,203	6,089,468	10,323,631
1905	4,594,782	4,918,480	9,513,262
1906	6,731,165	7,216,060	13,947,225
1907	7,329,317	7,143,818	14,473,135
1908	6,917,663	7,002,474	13,920,137
1909	7,625,639	6,927,875	14,553,514
1910	8,327,069	6,597,506	14,914,575
1911	8,422,447	8,560,346	16,982,793
1912	9,006,030	6,820,266	15,886,296
1913	9,232,543	8,976,271	18,208,814
1914	9,865,016	8,908,470	18,773,486

Cane vs. Beet

It will be seen that the race, as thrilling a one as was ever run in the sport of Kings—started neck and neck; beet with its impetus was going strong in the '90s, a length and a half ahead; by the middle of the nineteen-hundreds cane had regained her wind and closed her decade in the lead; since then beet has not been alongside; and if the final figures for 1915–16 were known, her percentage showing, partially because of the curtailment of beet-growing in Germany, Austria, France, and Russia, would quite likely be the poorest in forty years. The estimates of Willett & Gray and F. O. Licht are:

World's 1915–16 Sugar Crop:

Cane	Beet
10,333,000 tons	6,306,102 tons

Let us look into the facts, then, observing the fundamentals underlying the struggle and see if we can forecast the outcome.

Cuban Cane Sugar

Let it be stated at the outset that there is no difference between beet sugar and cane sugar when refined. In their chemical composition, in their quality and taste, and in their commercial value, they are identical. The only question is which can produce a pound of crystallized sugar, delivered to the consumer, at the least cost.

The climatic conditions required for the profitable production of sugar beets are entirely different from those required for the production of sugar cane.

Sugar cane started in the tropics and has never been coaxed very far from its native zone. It needs a nine months' growing season of hot days and nights, and it will not stand severe winters. It requires both moisture and sunshine, and unless irrigation is resorted to, needs an annual rainfall of from fifty to

sixty-five inches. Given favorable growing conditions, such as the cleared jungle of Cuba or Java, it requires a minimum of labor.

Sugar beets, on the other hand, constitute a typical temperate zone crop. They require rich soil, and especially good drainage conditions. If there is not abundant rainfall, the beets must be irrigated. Unless the soil is very rich in natural fertilizing ingredients, it becomes necessary to apply commercial fertilizer generously. The beet is a crop which requires constant cultivation during the early part of the growing season and is subject to a number of enemies and diseases. It has been noted that as the beet crop has increased, its enemies have become more widespread and destructive each year.

We see, thus, that the beet requires land which is worth from forty to two-hundred dollars per acre for

other purposes, whereas, cane flourishes best in the tropics with land, which, assuming that the Mahogany and Cedar pays the cost of clearing, costs from six to fifteen dollars per acre and is good for little else.

The beet requires expensive irrigation, cultivation and care, involving high priced temperate zone labor; whereas the cane, in equally suitable surroundings requires no irrigation and little or no cultivation—only harvesting by cheap tropical help at a few cents a week.

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To put the comparison in money, it may be stated that the average producer of beets in the United States realizes an annual profit of from fifteen to forty dollars per acre, with land costing from forty to two hundred dollars as his investment; while the average producer of Cuba realizes an annual profit of from thirty

to eighty dollars per acre from land costing six to fifteen dollars per acre.

Looking at the situation in this light, it would seem strange that beet should have made the advance it has. But there is another reason for this; the stronghold of the beet is in Germany, Austria, France, Holland, and other nations of Central Europe. These nations have a fourfold reason for growing the beet; first, they are far removed from the jungles where cane sugar best grows; second, they have the added incentive of a hundred years of development, improvement and investment in the beet; third, their labor costs are low; fourth, there are no "big-money" crops competing with sugar-cane for the land.

As to labor, it will be readily understood, that this is a most important item of expense in beet sugar production.

Where we, in the United States, pay one dollar to a dollar-and-a-half a day for field labor, the average cost in Germany and France is from fifty to seventy cents per day; while in Austria farm and unskilled factory laborers receive only fifteen to thirty cents per day.

If we add to these facts the further fact that, because of duties, taxes, bounties, and transportation, the retail price of cane sugar in Central Europe is much higher than in America, we will see the real underlying cause of the rise of beet.

As to "big-money" crops which wrest the land away from the beet, this is a condition met generally in the United States.

Whether or not the production of beet sugar in any given section can be made a permanent success has been shown to depend largely upon whether or not that section is adapt-

ed to crops yielding a greater return. For example, land which could formerly be bought in Idaho for $75.00 to $100.00 per acre as beet land has now risen in price from $150.00 to $300.00 per acre because of its adaptability to fruit growing.

In Idaho, Colorado, and other states the beet crop, thus, is rapidly being supplanted by fruits and vegetables with which the beet cannot be expected to compete in earning power.

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There are many other causes which underlie the recession of the beet and from which its further decline may be forecast.

Among these is the fact that the milling season is an extremely short one, and because of this beet sugar factories in many states import raw cane sugar to carry their production period over into what would otherwise be idle seasons. In almost every

case where this has been tried the raw cane sugar has proven a better profit earner for the mill than the beets which lay close at hand.

* * * *

Summing up, we see that beet stole a lead on cane because beet had the best minds of Europe improving it while cane suffered from tropical sloth. Beet is at the maximum of its efficiency, while cane has just begun to take its first steps.

The same inventive genius is now being applied to the improvement of cane and when this improvement reaches its maximum, as it will during the next few decades, it may confidently be expected that beet will take but a minor part in the production of the world's sugar.

CANE CARS ARE AS COMMON IN CUBA AS COKE CARS ARE AROUND PITTSBURGH

IV. Cuba—The Sugar Bowl of the World

If our sugar crop is to be multiplied by seven as prospective needs seem to require, we must, in a survey such as this, see where the increase is to come from; and, assuming that beet, under the double stress of ever increasing competition from better-paying temperate-zone crops and improvement in the production of cane, is to be less and less in evidence, we must see where cane, particularly, can be extended.

After fourteen centuries of experiment with cane, two spots have established themselves as pre-eminently suited to its culture—two spots have been found where soil, temperature, rainfall, and all of the other necessary elements seem to

have conspired together to create ideal conditions for cane.

These spots, both islands, one in the West Indies, one in the East, are Cuba and Java.

Cane is raised successfully in India, in Australia, in South America, in South Africa, in Formosa, in the Philippines, in Hawaii, in the gulf section of the United States, in Mexico, in Porto Rico, and other islands of the West Indies.

But of all these localities, Cuba and Java seem, by nature, best fitted for the production of this crop.

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Cuba and Java are both long, narrow islands of about the same area, one lying about as far north of the equator as the other lies south; both have about the same amount of heat, moisture and wind; but in the extreme fertility of its soil Cuba shows a marked superiority over Java.

World's Sugar Bowl

In our minds, quite likely, we picture these islands as being smaller than they really are.

Cuba, for example, if laid down on the United States with its eastern end at New York City, would extend almost to Cincinnati. It varies in width from twenty-two to 160 miles. Its area is almost the same as that of England; or to bring the comparison nearer home, Cuba is larger than Indiana, Pennsylvania, or Ohio —not quite so large as New York, Illinois, or Wisconsin. It is considerably larger than the combined areas of Connecticut, Rhode Island, Massachusetts, New Hampshire, and Vermont.

In population it is about the same as California, Indiana, Iowa, or Wisconsin.

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A glance at the figures showing Cuba's present importance in the

production of cane sugar may be of interest.

Country	Short Tons
Cuba	3,000,000
British India (consumed locally)	2,400,000
Java	1,264,000
Hawaii	585,000
Porto Rico	350,000
Philippines	300,000
Peru	200,000
Brazil	194,000
Argentina	175,000
State of Louisiana	150,000
State of Texas	1,000

The secret of Cuba's superiority lies in both the quantity and quality of her soil.

With a depth, in some places, of as much as thirty feet of soil, the richness is such that cane, with a single planting, will bear its annual crop for from seven to ten years; while in the two next important cane countries—Java and British India—replanting is done every year.

In Cuba, too, the seasons are ideal for the economical production both

of cane and of raw sugar. The warmest months are from May to October, and these are the rainy months. The distribution of the rain during this hot spell is such that a much smaller quantity of water is required than would be the case in other regions where the rainfall is less evenly distributed.

When the six months' rainfall is at an end, and the cane is ready to harvest, a six months' dry period sets in; and with the resultant dry fields and dry roads, the operations of harvesting and grinding are accomplished under the most favorable conditions.

When the Cuban grinding season—December 1st to May 1st—is finished, the fields are green again and the cane is well on its way toward the next season's crop.

There are, in fact, cases on record of fields which still yield satisfactory

crops, season after season, without fresh planting, after having been cut uninterruptedly for thirty years.

In Hawaii, on the other hand, long famous for its sugar production, the cane not only must be planted for every second or third crop, but eighteen months of continuous, intensive cultivation is required to bring a crop to maturity.

* * * *

The history of cane sugar in Cuba reads like a romance.

About twenty years elapsed after the discovery of Cuba, by Christopher Columbus, in 1492, before sugar cane was sent by Spain to Cuba for planting. The experiment showed the Spaniards the perfect suitability of Cuba's fertile soil for cane's growth and development; but the Spanish government of the sixteenth and seventeenth centuries was gold-mad and discouraged agri-

cultural productions of all kinds in favor of mining. Indeed, after a very few years, the cultivation of sugar cane in Cuba was forbidden, and even after that prohibition was withdrawn, cane was permitted to be grown only under governmental monopolies and privileges which had such a restrictive influence that no real progress was made with cane on the Island until about 1772.

After that year, however, any Spaniard was free to produce sugar, and this led to such an increased production that the exportation more than trebled in thirty years.

By 1800 Cuba had 870 sugar factories and was exporting more than 40,000 tons a year. Owing to Napoleon's "Continental System" which took Europe out of Cuba's market during the first years of the nineteenth century, the industry suffered heavily; but after Napoleon's fall,

with intercourse again established, Cuba's sugar began to expand at even more than its former rapid rate.

Although the production thus increased, the methods of cultivation and manufacture remained crude and primitive. During this period no reliable statistics were recorded, but it is known that in 1870 the yearly output ran to 725,000 tons which represented the product of no fewer than 1,000 small factories. This period of prosperity was brought to an end by the abolition of slavery and by the "Ten Years' War" with Spain. This war, one of great bitterness on both sides, not only paralyzed commerce but led to the devastation of much sugar property.

It was during this period, too, that the competition with beetroot sugar first became noticeably threatening. After the war was over, however, in 1878, the annual output

rose again so that, in 1890, 625,000 tons were produced from about 470 factories. From this point, the production went steadily upward until it reached a maximum of something over a million tons in 1894.

In the following year, 1895, however, the final rebellion against Spain broke out, and after much devastation, it ended in the Spanish-American War, and ultimately in the establishment of the Cuban Republic. This period of strife was the worst in the entire history of Cuba—on both sides property was burned and destroyed, cattle were killed, and other reprisals put into effect for the purpose of cutting off an opponent's livelihood—for the Island itself was far from being a unit on the question of rebellion.

Owing to the demolition of factories, the burning of cane fields and the destruction of work-cattle, and

the enlistment of citizens in the armies, it became almost an impossibility to carry on the sugar industry at all. In spite of the strict orders issued by the Spanish authorities to continue grinding, the production, in 1897, went down nearly to 200,000 tons.

As can be well imagined, the industry recovered but slowly when this period of misery and destruction had come to an end; factories had been destroyed; the working population had been reduced and made more or less unfit for work; work-cattle, representing the sole means of cultivation and conveyance, had been wantonly destroyed; the financial situation was such that manufacturers were unable to raise the funds necessary for rebuilding factories or equipping them; and a general period of reconstruction and centralization set in.

Notwithstanding this set-back, production rose from 212,051 tons in 1897 to 612,775 in 1901, passing the million ton mark in 1903, the million-and-a-half ton mark in 1909, the two-million ton mark in 1913—and, with the 1915-16 season, passed the three-million ton mark.

* * * *

There are other islands in the West Indies and surroundings which, by reason of location and climate, might seem as well suited to sugar production as Cuba.

There are several reasons why they are not—but the chief of these is that the United States Government has stamped out the old political unrest—the wars and revolutions with their bloodshed—which, formerly kept Cuba down, while all of Cuba's neighbors, save Porto Rico alone, are still living, politically, in

the tempestuous pirate-times of centuries ago.

If we look at Cuba's less fortunate neighbors—and at the sugar belt which girdles the earth—it would seem as if the same tropical rains and sunshine which are needed for the production of cane also conspire to form an ideal atmosphere for fomenting political unrest. Hayti, Guatemala, San Salvador, Honduras, Nicaragua, Costa Rica, and Colombia —all of these are sugar producing countries on a limited scale, but so subject to outbreaks are they, that their sugar industries have never presented an inviting appeal to the capital necessary to bring them to their maxima.

In Mexico, from which much might otherwise be expected, there is chaos, and the threat of continued chaos, while Cuba, much better suited by soil and climate to sugar production,

with the United States Government fostering her, and irrevocably bound to continue safeguarding her, enjoys a stability which may well be compared with the stability, for example, of the State of New Jersey.

Cuba has always had her soil; she has always had a market for more sugar than she could produce. Yet in her first century of sugar production she reached a bare million tons of production; while in the seventeen years since she has been a Republic, in spite of the set-back of a reconstruction period, her production has jumped to three million tons.

* * * *

The chief problem in sugar growing (as in the manufacture of any commodity) is the cost of production.

As to Cuba's cost of production, Willett & Gray quoted in 1910 the following figures: Cuba sugar, f.o.b. Cuba, costs $.0185 per pound or

$.0195 per pound c.i.f. New York. They fixed $.02 per pound as the maximum f.o.b. Cuba cost price, and $.015 per pound as the minimum.

Undoubtedly, in the six years which have intervened, the cost of production has been still further reduced; and with American capital and ingenuity going into Cuba as they are, another decade or so must see production costs brought down still nearer the irreducible minimum.

But if no further reduction could be wrought, Cuba stands and always must stand in an enviable position with relation to the largest buyer of sugar in the world.

Spreading out over and around her, within easy access, lies the United States which buys and consumes about four million tons of sugar a year. Less than one-fourth of this comes from Porto Rico, Hawaii, and the Philippines; less than one-sixth

is beet sugar grown within her own borders; less than one-twentieth is cane sugar of her own growing.

The figures of Willett & Gray show that in 1914 the United States imported 2,066,912 tons of cane sugar in addition to all the sugar production of her own states and territories. Cuba, therefore, had at her very door a ready market for practically four-fifths of her 2,597,732 ton crop.

The United States, of course, is not her only market; Cuba is nearer to England than India; nearer to Central Europe than Java. And the recent past has shown that the slightest strain in Europe pulls instantly on the Cuban sugar supply.

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Porto Rico cannot much increase her output; her total area is considerably less than that of New Jersey, and only a small portion of this, on the coastal regions, is suited

to cane-growing. Hawaii cannot compete with Cuba's natural advantages to the point of much further extension; the Philippines have not shown much progress, their sugar industry is still in its experimental stage; and Mexico is out of the sugar race for many years to come, even if ideal political conditions could prevail and continue.

* * * *

It would seem that nature had outdone herself to make Cuba the sugar bowl of the world; and that civilization had done her part in settling the world's largest market for sugar right at her shores.

What further the future holds in store for Cuba and her sugar, depends now on the skill and enterprise of man.

Cuban Sugar can be as big as Mind and Capital can make it—and therein lies America's Opportunity.

A TYPICAL CUBAN SUGAR MILL—NOTE THE OX-DRAWN CANE CARTS

V. Cuban Cane Sugar—America's Opportunity

An English physician living on the little island of Trinidad observed one day that grass-like plants were coming up here and there in the cane fields.

The planters whom he asked about it told him it was grass, and showed no further curiosity. The physician, however, unable to account for grass seeds having fallen there, suspected that these were really the shoots of seedling sugar-canes.

It developed later that both the planters and the physician were right. The little shoots were young sugar-cane plants; but since sugar cane itself is a giant grass, there was no mistake.

The importance of the physician's observation lay in the fact that sugar-

cane had been believed, for ages, to be sterile; no such thing as a seedling of sugar cane had ever been heard of.

There is, be it known, a small company of cultivated plants which have almost altogether given up the habit of seed-production. The horse-radish, for example, has so long been seedless that offers of $50,000 have been made for a thimbleful of its seed. Similarly, the common potato has almost abandoned the habit, and the marked improvement in our potatoes as against those of thirty years ago is due wholly to the fact that some seed-bearing potatoes were accidentally discovered.

The cane, for ages, has been propagated in the same way that the potato has. When potatoes are planted, one of the twenty-seven eyes of a potato is merely placed in the ground and left to sprout; when

cane is planted, one of the short segments of the stalk is placed in the ground and soon throws out roots of its own. When plants are propagated in this way, there is no chance for variation and consequent improvement. It is the same old plant growing over and over again—there are no new combinations of heredity to combine in working the wonders of variation.

The discovery of cane seedlings, thus—although undoubtedly there had been many such seedlings, unnoticed, before—was one, therefore, of the utmost importance.

The Trinidad physician, full of enthusiasm at uncovering one of Nature's secrets, transplanted a number of the cane-seedlings, brought them to maturity, and found several new and apparently superior varieties of the cane among them.

One of these was carried subse-

quently to the Hawaiian Islands where it was propagated in the usual way, so that, in due course, sufficient plants were raised from it to be tested as to their qualities of growth, hardiness, and sugar-production. It was soon discovered that the progeny of this seedling constituted virtually a new race of sugar cane; one that would grow on land so poor that it had been allowed to remain fallow. The new variety, indeed, was found to produce more sugar on even the poorest land than the ordinary variety produces on good land.

The impetus which this discovery gave to the study of improving the cane may in a large measure account for Hawaii's great superiority, in the quality of cane raised, over other cane-producing countries.

In Hawaii, today, not only is the acreage output the highest of any

cane-growing country, but the sugar content of the cane itself is higher. Hawaiian cane averages more than sixteen parts of sugar to 100 parts of cane, whereas Cuban cane averages less than twelve parts of sugar to 100 parts of cane. Hawaii, with certain natural disadvantages, could not, in fact, market sugar profitably with less efficient production.

* * * *

This brings us to the first great sugar opportunity of Cuba—improvement in the kinds of cane grown, and improvement in cane-growing methods.

In spite of the fact that Cuban cane-growers have long known of better varieties which might easily be procured for planting, yet these innovations have not been welcome. The planters are familiar with the varieties now in use, while new kinds, of course, must first be tried out.

In countries where planting is done every year, such trials entail little risk; for should the crop be a partial failure, it affects only that year and involves no further loss. But in Cuba, where planting is done but once in from seven to ten years, the selection of the wrong kind of cane would bring ruin.

So Cuba's cane-growers, with neither the land nor the resources, nor the enterprise to experiment, have sat idly back, planting, in most cases, the same old varieties which the Spaniards brought over decades ago.

Since there are varieties of cane known which produce about twenty-five per cent. more sugar than the present Cuban cane, there is obviously incentive, a-plenty, for experimentation with better varieties of cane—if the experimenters operate on a scale large enough to insure

constant earnings while the experimentation takes place.

Nor can it be doubted that the scientific plant-breeder can work a much greater increase, even, than is represented by the best varieties now in existence. By cross-breeding and selection, if enough experiments be tried, it will be possible to evolve a variety of cane which will get the utmost out of the wonderful soil Cuba offers as a habitat.

To the hand-to-mouth owner of a small plantation, such experiments seem out of the question. But to a company with a 100,000 to 500,000 ton production, experimentation upon a scale bound to bring success would cost a mere fraction of a per cent. of its earnings.

The result, on the other hand, if, for example, a twenty-five per cent. increase of sugar per 100 parts of cane were secured, would represent

not merely a twenty-five per cent. increase in earnings, but might mean even trebled or quadrupled earnings; for—since it costs no more to plant, or cultivate, or harvest, or crush the cane—every additional per cent. of sugar secured can be counted net gain.

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The development of better suited varieties of cane, however, represents but a small part of the opportunity offered in improved sugar production. Equally great advances might also be attained through better methods of soil tillage, maintenance of property and plantation management.

As matters now stand, deep plowing is almost unknown in Cuba—scratching the soil has always brought a crop, so surface scratching is all the soil has had. Once the same thorough methods that are the

rule in Iowa, or the Dakotas, or California, are introduced into Cuban cane culture; amazing results may reasonably be expected.

The truth is that the land is so rich and the climate so well suited to cane, that those simple methods of making agriculture pay, which every other farmer employs, have been neglected and shunned; and the cane crop has been left to the graces of a too bounteous Nature.

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A story is told of an undertaking, some years ago, to provide the American Indian with better means of earning his livelihood. The question was asked of a wise Indian commissioner if, in his estimation, the Indian could successfully engage in raising sugar beets.

"Yes," was the reply, "if he could do it on horseback."

Very similar, indeed, has been the

attitude of the Cuban cane-grower toward his cane.

* * * *

Great as is the opportunity of improving Cuban agriculture, greater still is the opportunity of improving Cuban manufacturing.

In Hawaii, for example, where sugar efficiency, both in growing and in manufacturing has always to be at its best, as high as ninety-five per cent. of the sugar in the cane is extracted. In Java, Cuba's nearest competitor, the extraction averages well over ninety per cent. But in Cuba, in spite of much modern machinery, the extraction is materially less. While the definite figures are not available, there is good authority for the statement that the average loss of sugar in Cuba exceeds that of any other cane growing country.

One reason for this wastage is

the Cuban climate. The same well distributed rains which make the cane grow as it does, serve also to make the cane fields and the roads impassable to the harvesters. The grinding, therefore, is limited to the six months' dry season. During this season the sugar content varies, from eight per cent. at the beginning of the season up to twelve and fifteen per cent., and even more, at its end.

The same hand-to-mouth policy which has been in evidence in Cuban cane-growing here comes to the surface in Cuban raw sugar manufacturing. Instead of properly planning the grinding of the crop so as to distribute it over the grinding season, thus gaining the highest percentage of extraction, growers have been in the habit of holding their crops as long as they dared for a higher sugar content, while the mills

lay idle; much good cane has thus been lost because in the final-moment rush the mills were taxed far beyond their capacity. It has become the practice of mills, thus, to bend every effort toward handling the largest quantity of cane, paying little attention to the wastage which such high pressure methods involve. And the net result has been that Cuba has wasted a considerable percentage of her sugar which, simply by efficient management, might have been saved.

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Sugar-growing, and sugar-growing in Cuba, particularly, must, essentially, be a large scale operation.

The small grower, today, finds himself unable to compete with even the few moderate-sized sugar undertakings which have sprung up in Cuba; and with production becoming better and better organized,

as it must, his position will become more and more difficult.

Quite clearly the tendency toward centralization in the business has been written into the figures: in 1800, with a 24,000 ton production of sugar, there were 870 factories in Cuba; by 1870, with a 725,000 ton production, there were 1,000 factories—a 3200 per cent. increase in production with only a sixteen per cent. increase in the number of factories—already centralization on a small scale had begun to set in; in 1890, with a 625,000 ton production, there were but 470 factories; while in 1911, with nearly a 2,000,000 ton production, there were but 168 factories.

Yet organization and centralization, which, as can be seen, have been the tendency for more than a century, are really only at their beginning in Cuba—sugar operations

from this time forward must be upon larger and larger scales, and the trend of developments give promise that they will be.

Cuba has much modern sugar machinery and many modern sugar mills; she needs all these, and more like them; but Cuba's big opportunities are not alone for the machinery salesman; the big opportunities she presents are for enterprise and efficiciency; the same kind of enterprise and efficiency that have placed American steel, American automobiles, American farm machinery and other American products in the forefront of the world's markets. And for such enterprise and efficiency, her sugar can afford to pay, as neither steel nor automobiles nor farm machinery have ever been able to pay.

* * * *

Just as Cuba has conducted her cane-growing and her milling in a

hand-to-mouth fashion, so too has she conducted the marketing of this, her most important crop.

Cuba's cane-growers have always been at the mercy of the fluctuations of the market—at the mercy, sometimes, of artificial conditions created for the purpose of making the market fluctuate. The growers, in times of plenty, have been compelled to sell at a low market, and have found themselves, later, in times of scarcity and with prices soaring, without a product to deliver. The producer thus has suffered, at no advantage to the consumer. Nature has made Cuba strong in sugar, but inefficiency has made her weak in finance, and she has been pinched and squeezed in times when she might as easily have dictated.

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Cuba's great opportunity, thus, will belong to Capital—fearless capi-

tal which shall lift her chief industry out of its Spanish lethargy—capital to provide improvements in agriculture and in manufacture—capital, with confidence, to create marketing conditions, instead of being the slave of them.

Already American capital is working wonders for Cuba in other lines—already it has spanned her length with a modern railroad and brought the island within train and ferry distance of New York; and already American investment in transportation is beginning to reap its reward.

* * * *

Improved methods of cane-growing—up to date agriculture; improved methods of sugar-making—up to date manufacturing; improved methods of marketing—up to date merchandising; these are the definite ways in which Cuban cane sugar can be placed on a higher plane. These

are the definite opportunities, therefore, which are now opened up to American industry, efficiency and capital.

[The End]